Boning Up on Osteoporosis

Question 1

How many people in the US have osteoporosis?

A. 5 million
B. 10 million
C. 15 million
D. 20 million

Question 2

Which of the following bones is primarily composed of trabecular bone?

A. Lumbar spine
B. Hip
C. Mid-radius
D. Finger
**Question 3**
What are the primary bone cells responsible for bone formation?

A. Osteoclasts  
B. Osteoblasts  
C. Osteocytes  
D. Bone lining cells

**Question 4**
Which of the following is NOT a risk factor for osteoporosis?

A. Female gender  
B. Cigarette smoking  
C. Small body frame  
D. Being overweight

**Question 5**
What is the gold standard for diagnosing osteoporosis?

A. Risk factor assessment  
B. Central DXA or DEXA testing  
C. Ultrasound testing  
D. Biochemical markers
Learning Objectives
At the conclusion of this program participants should be able to:
- Define osteoporosis and describe its prevalence and classification
- Describe the basic pathology of osteoporosis
- Discuss the risk factors associated with developing osteoporosis
- Identify some secondary causes of osteoporosis
- Describe the clinical presentation of osteoporosis
- Explain the role of DXA and ultrasound devices in clinical practice and the limitations of use
- Define T-score and list the diagnostic categories based on this measurement

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- Board Certified Pharmacotherapy Specialist and Fellow of the American College of Clinical Pharmacy
- Currently an Assistant Professor of Clinical Pharmacy and Family Medicine with the University of Colorado

Introduction and Background
Pathophysiology
Continuing Attention

- Older persons are the most rapidly growing demographic group
  - 30 million women are peri- or postmenopausal
- Advances in diagnostic technology
  - BMD testing
- Advances in pharmacotherapy
  - Only since 1995 that drugs other than estrogen have been approved for osteoporosis
- *Decade of the Bone & Joint (2002-2011)*

Bone Health and Osteoporosis: A Report of the Surgeon General

- First ever Surgeon General’s report on this topic
- Purpose: to improve the bone health of Americans
- Call for action
- [http://surgeongeneral.gov/library/bonehealth/content.html](http://surgeongeneral.gov/library/bonehealth/content.html)

Many unanswered questions remain

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Program Content

- Review of Pathophysiology
- Preventive Therapy
- Drug Therapy
- Patient Care Issues
- Pharmacy Based BMD Testing

Treatment Guidelines


Definition

- A systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture

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Osteoporosis

- The “Silent Thief”
- Risk factor for fracture
  - Fracture is the relevant clinical sequela

Prevalence

- Osteoporosis is a national health care problem
- Approximately 10 million people in the U.S. have osteoporosis of the hip
- Less than 1/3 of cases have been diagnosed
- Only 1/7 of American women with osteoporosis receive treatment
- 50% of Americans over the age of 50 will be at risk of fracture by 2020 if nothing is done
Osteoporosis is NOT age or gender dependent.

Economic Impact of Osteoporosis
- Direct costs in 2005 were almost $14 billion
  - Hip fractures accounted for 63% of cost
  - 63% of costs were for hospital services; 28% for nursing home care
- The government pays most of the costs of osteoporosis in women > 45 yo
  - Medicare pays 48%
  - Medicaid pays 24%
- Indirect costs unknown

Functions of the Human Skeleton
- Structural
- Metabolic reservoir
Cortical versus Trabecular Bone

<table>
<thead>
<tr>
<th>Function</th>
<th>Cortical Bone</th>
<th>Trabecular Bone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>Protective</td>
<td>Mechanical Metabolic</td>
</tr>
<tr>
<td>Distribution</td>
<td>Mainly appendicular skeleton</td>
<td>Mainly axial skeleton</td>
</tr>
<tr>
<td>Location</td>
<td>Outer walls of bones</td>
<td>Interior structures of bone</td>
</tr>
<tr>
<td>% of Adult Skeleton</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Bone Composition

<table>
<thead>
<tr>
<th>BONE</th>
<th>% Cortical</th>
<th>% Trabecular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midradius</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>Heel</td>
<td>10-25</td>
<td>75-90</td>
</tr>
<tr>
<td>Femur neck</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Finger</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Lumbar spine</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>
What Are Bones Made Of?
- Calcium and phosphorus crystals
- Collagen fibers

Bone Remodeling
Serves two major purposes —
- To renew bone continuously
- To maintain mineral homeostasis

Bone Remodeling
Three sequential stages
- Resorption
- Formation
- Bone mineralization
Bone cells involved
- Osteoclasts
- Osteoblasts
- Osteocytes
Bone Remodeling Cycle

Formation by osteoblasts
Resorption by osteoclasts
Osteoblasts
Osteoclast recruitment
Bone lining cells
Bone

Resorption
Formation

Osteoporosis

Resorption
Formation
Alterations in Remodeling

- High-turnover bone loss
  - Due to increased function & lifespan of osteoclasts
  - Results in more remodeling sites / deeper resorption sites thus exceeding the actions of osteoblasts
  - Most common in postmenopausal women

Alterations in Remodeling

- Low-turnover bone loss
  - Due to decreased function & lifespan of osteoblasts
  - Results in inadequate filling of normal remodeling sites
  - Most common in the elderly

Factors Influencing Development of Osteoporosis

- Peak bone mass at maturity
- Rate of age-related bone loss during later life
Peak Bone Mass

- The highest level of bone mass achieved at skeletal maturity
- Attained between ages 25 – 35
- As much as 70% of peak bone mass is genetically determined

Peak Bone Mass “Bone Mineral Bank”

CRITICAL LEVEL

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Genetic factors exert a predominant influence on peak bone mass but environmental & modifiable lifestyle factors can play a significant role.

An individual who does not reach optimal bone mass may develop osteoporosis without occurrence of accelerated bone loss.
Factors Affecting Peak Bone Mass

- **Nutritional Factors**
  - Calcium
  - Vitamin D
  - Anorexia nervosa

- **Hormonal Factors**
  - Amenorrhea

- **Environmental Factors**
  - Smoking
  - Alcohol use
  - Caffeine
  - Medications

- **Genetic Factors**
  - Gender
  - Race
  - Body stature

- **Physical Activity**

- **Medical Conditions**

### Age-Related Bone Loss

- **Protracted slow phase (men & women)**
  - Starts around age 35
  - Lose bone at a rate of 0.5-1% per year
  - Due to ↓ osteoblastic activity and ↓ GI calcium absorption

- **Transient, accelerated phase (women)**
  - Occurs after menopause
  - Lose bone at a rate of 2-5% per year for 5-10 years
  - Bone loss of up to 20% occurs during first 5–7 years after menopause
  - Due to ↑ osteoclastic activity

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Factors Affecting the Rate of Age-Related Bone Loss

- Nutritional Factors
  - Calcium
  - Vitamin D
- Environmental Factors
  - Smoking
  - Alcohol use
  - Caffeine
  - Medications
- Genetic Factors
  - Gender
  - Race
  - Body stature
- Hormonal Factors
  - Menopause
- Medical Conditions
- Physical Activity

Bone Loss Over Lifespan

- **Women**
  - Lose 30 – 50% of trabecular and 25 – 30% of cortical bone mass
- **Men**
  - Lose 15 – 45% of trabecular and 5 – 15% of cortical bone mass

Bone Mass in Women

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Bone mineral density is related to bone mass at maturity (peak bone mass) and subsequent bone loss.

Determinants of Peak Bone Mass and Rate of Loss: Risk Factors for Osteoporosis and Fracture

- Gender
- Race
- Body Weight
- Family History

Genetic Factors
Genetic Factors

1. Gender
   - Women are 4 times more likely to develop osteoporosis than men
     - Peak bone mass: Men > Women by about 30%
     - Menopause

Genetic Factors

2. Race
   - Caucasian and Asian women at greatest risk

Genetic Factors

3. Body stature
   - Small frame = ↑ risk
   - ↑ weight = ↓ risk
     - Low body weight (<127 lbs) is considered to be a risk factor
     - No recommended BMI for optimal bone density
       - BMI < 22.24 = less BMD than BMI >26-28
       - BMI >30 not desirable
Genetic Factors

4. Family History
   Maternal and/or paternal history of hip, wrist or spine fracture when the parent was age 50 years or older (NOF)

Age

- ↓ Estrogen
- ↓ Osteoblast activity
- ↓ Activation of vitamin D
- ↓ GI calcium absorption

Menstrual History

- Age at start of menses
  - After age 16
- Age at menopause
  - Before age 45
  - Bilateral oophorectomy
- History of amenorrhea
  - Prolonged premenopausal amenorrhea (>1 yr)
Lifestyle / Environmental Factors

- Cigarette smoking
  - Possible causes:
    » ↓ Estrogen serum concentrations
      - Undergo menopause earlier
    » Direct toxic effect on bone cells

Lifestyle / Environmental Factors

- Excessive alcohol use
  - Direct toxic effect on osteoblast activity = ↓ bone formation
  - ↑ falling
  - No more than 1 oz ethanol/day
- Excessive caffeine
  - ↓ calcium
  - No more than 2 servings per day

Lifestyle / Environmental Factors

- High dietary protein intake
  - ↑ protein = ↑ demand for calcium carbonate to buffer the acid burden caused by protein
- High dietary sodium intake
  - ↑ sodium = ↑ urinary calcium excretion

If dietary calcium is adequate, effect of protein & sodium intake on calcium levels will NOT matter
Lifestyle / Environmental Factors

- Carbonated beverages
  - Possible causes:
    - High phosphorus intake may result in secondary hyperparathyroidism
    - Tend to consume less milk in favor of soda
  - More study needed

Teenaged Girls, Carbonated Beverage Consumption, & Bone Fractures


- Patient Pop: 460 9th & 10th grade girls from an urban H.S.
- Design: Retrospective study of self-administered questionnaire results
- Results:
  - 80% drank carbonated beverages
  - 45% physically active
  - 20% had prior fracture
  - Overall, girls who drank carbonated beverages had 3.14 fold greater likelihood of having a fracture

Lifestyle / Environmental Factors

- Physical activity
  - ↓ mobility = ↑ bone loss
  - ↑ exercise = ↓ bone loss
Lifestyle / Environmental Factors

Medications
- Corticosteroids
- Excessive thyroid hormone
- Phenytoin
- Aluminum-containing antacids
- Some antineoplastics
- Heparin

Medications – newest addition
- Medroxyprogesterone injection (Depo-Provera®)
  » Bone loss is greater with increasing duration of use
  » Bone loss may not be completely reversible
  » Only use long term (>2 yr) if other birth control methods are inadequate
  » Reevaluate use in females with osteoporosis risk factors

Medications – more study needed
- Warfarin
- Protease inhibitors
Disease States

- Multiple myeloma
- Hyperparathyroidism
- Hyperthyroidism
- Obstructive jaundice
- Type 1 diabetes
- Rheumatoid arthritis
- Severe malnutrition
- Hypogonadism

History of Prior Fracture

- Previous vertebral or hip fracture is the most important predictor of fracture risk
- History of vertebral fracture increases subsequent spine fracture risk by 5 times and nonspine fracture by 2 times
- The future fracture risk is 20% in the year following an vertebral fracture in women on no medication

Risk Factors for Osteoporotic Fracture

- Dementia
- Impaired eyesight
- Recurrent falls
Postmenopausal osteoporosis has been shown to develop more readily in women who have one or more risk factors. The absence of risk factors does not predict total freedom from osteoporosis.

KEY POINTS

There are few studies that evaluate how to use these risk factors to identify individuals at risk for osteoporosis or fracture.

Phases of Bone Loss

- Normal Bone – 90-100% of peak bone mass
- Osteopenia – 75-90% of peak bone mass
  - Thinning bone
  - Microarchitecture intact
  - Slightly higher risk of fracture
- Osteoporosis – <75% of peak bone mass
  - Thinning bone
  - Microarchitecture disrupted
  - High risk of fracture
Classification of Osteoporosis

- **Primary osteoporosis**
  - Age-related, hormonal or idiopathic

- **Secondary osteoporosis**
  - Chronic disease states, drug therapy or lifestyle

Secondary Osteoporosis

- **Perimenopausal women**
  - > 50% of cases due to secondary causes
  - Most common: hypoestrogenemia, use of glucocorticoids, thyroid hormone excess & anticonvulsant therapy

- **Men**
  - About 60% of cases due to secondary causes
  - Most common: hypogonadism, use of glucocorticoids & alcoholism

Osteoporosis is a latent disease with a 20-30 year lag period between the onset of bone loss and incidence of fracture.

During the lag period, the patient is usually asymptomatic.
Osteoporotic Fractures

Bone Strength
- Bone strength reflects the integration of two main features:
  - Bone density: grams of mineral per area. Accounts for approximately 70% of bone strength
  - Bone quality: refers to architecture, turnover, damage accumulation and mineralization
Osteoporotic Fractures

- Primary sites in order of presentation
  - Wrist
  - Spine
  - Hip

Wrist Fractures

- >250,000 annually
- Generally a result of trying to break a fall
- Most likely to occur between 50 – 70 yo
- Associated with little disability
- A warning of cortical bone loss
  (Radius = 25% trabecular & 75% cortical bone)

Vertebral Fractures

- >700,000 annually
- Most likely to occur between 50 – 70 yo
- Associated with pain and deformity
- Significant psychological impact
  - Depression
  - Poor self-image
  - Social isolation
Clinical Features of Vertebral Fractures

- Gradual height loss
- Dorsal kyphosis with “dowager’s hump”
- Protuberant lower abdomen
- Chronic back pain

Hip Fractures

- >300,000 annually
- Occur relatively late in course of disease
- The median age of a first hip fracture is 79 years
Hip Fractures
- Primary cause of morbidity, mortality, and cost
- Impact:
  - About 20% of women do not survive one year
  - About 30% have permanent disability
  - About 50% are unable to return to independent living, many requiring nursing home care

Other Fractures
- > 300,000 annually
- Other skeletal sites are not immune to bone loss, thus fractures may occur

Lifetime Risk of Fracture at Age 50 for Caucasian Women
- Hip 17.5%
- Vertebra 15.6%
- Forearm 16%
Clinical Complications of Fracture

- Pain
- Deformity
- Disability
- Physical deconditioning due to inactivity
- Changes in self image
- Death

NOF Gallup Survey: Women Who Have Experienced a Bone Break

- Experienced pain: 85%
- Lost height: 70%
- Less able to perform daily activities: 64%
- Had to reduce activities with family & friends: 58%
- Posture was affected: 58%
- Less able to get from place to place: 54%
- Felt less attractive: 41%

Diagnosis and Monitoring of Osteoporosis
Diagnosis and Monitoring of Osteoporosis

- Risk factor assessment
- Physical exam
- Bone mass measurements
- Biochemical markers

Risk Factor Assessment

- Uses:
  - Indication of propensity to develop osteoporosis
  - Development of preventive strategies

Risk Factor Assessment

Limitation: does NOT determine the risk of fracture in a particular individual
**Physical Exam**

- Height measurements
  - Most people lose 1.5 to 2 inches in height
  - May lose up to 8 inches with vertebral fractures
- Presence of classic physical features
  - Gradual height loss
  - Dorsal kyphosis
  - Protuberant lower abdomen
  - Chronic back pain

**Bone Mass Measurements**

- Bone Mass or Density = amount of mineral contained within a certain amount of bone
- BMD is used as a proxy measurement of bone strength & accounts for approximately 70% of bone strength

**Society for Clinical Densitometry 1995**

The ability of bone mass to predict future fracture risk is as valuable as cholesterol testing or blood pressure measurements are for the prediction of heart attack or stroke and should be used more widely to identify at-risk patients.
Plain x-ray radiographic diagnosis of osteoporosis is insensitive and unreliable.

**X-Rays**

- Bone absorbs x-ray photons in proportion to calcium content
- Measures calcium in bone

**BMD Technologies**

- X-ray based
  - Measures speed of sound through the site
  - Assesses bone elasticity & structure
  - Gives estimate of BMD
BMD Measurement Technologies

- Dual energy x-ray absorptiometry (DXA or DEXA)
- Single-energy x-ray absorptiometry (SXA)
- Quantitative computed tomography (QCT)
- Radiographic absorptiometry (RA)
- Quantitative ultrasound

Bone Densitometry Techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>Body Site</th>
<th>Accuracy</th>
<th>Precision</th>
<th>Scan time (minutes)</th>
<th>Effective Radiation Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEXA</td>
<td>Hip, spine</td>
<td>90-99%</td>
<td>98-99%</td>
<td>5</td>
<td>&lt;Standard Chest X-ray</td>
</tr>
<tr>
<td>pDEXA</td>
<td>Forearm, heel,</td>
<td>90-99%</td>
<td>98-99%</td>
<td>1-5</td>
<td>&lt;Standard Chest X-ray</td>
</tr>
</tbody>
</table>
**DXA Testing**

- Central DXA testing considered gold standard
- No undressing required

**Bone Densitometry Techniques**

<table>
<thead>
<tr>
<th>Technique</th>
<th>Body Site</th>
<th>Precision</th>
<th>Scan Time (min.)</th>
<th>Effective Radiation Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound</td>
<td>Heel</td>
<td>92 – 98%</td>
<td>&gt;1</td>
<td>None</td>
</tr>
</tbody>
</table>
Ultrasound Testing

- Peripheral sites only
- Generally used for screening purposes

BMD Measurements

Uses:
- Establish or confirm a diagnosis of osteoporosis
- Monitor changes in BMD due to medical conditions or therapy
- Motivate ongoing therapy
Candidates for BMD Testing

AACE Guidelines

- For risk assessment in peri- or postmenopausal women who have risk factors
- In women who have X-ray findings suggesting osteoporosis
- In women on long-term glucocorticoids or other drugs associated with bone loss
- In women with diseases associated with bone loss (i.e., hyperparathyroidism)
- For monitoring therapeutic response in women receiving treatment
- In all women ≥ 40 yo who sustained a fracture
- In all women > 65 yo

Candidates for BMD Testing

NOF Guidelines

- All women > 65 years old regardless of additional risk factors
- All postmenopausal women ≤ 65 years old who have 1 or more additional risk factors for osteoporosis
  - Family history of osteoporosis
  - Personal history of low-trauma fracture after age 45
  - Current cigarette smoking
  - Low body weight

Other Thoughts on When to Test

- Initially test during 30s or 40s
  - Determines peak bone mass
  - Provides reference point
  - Early detection of problem
- Next test at menopause
  - If normal – repeat every 3-5 years
  - If abnormal – repeat periodically
Mass Population Screening

- No consensus
- Should be researched more before offering on a population basis

Site Selection

- Which site to measure for most effective risk assessment is unknown
- The decision is based on what the physician determines to be most clinically revealing for the patient

Sites for Measuring BMD

- Spine – Measures the 4 lumbar vertebrae
- Hip – Measures the following:
  - Femoral neck
  - Trochanter
  - Ward’s triangle
- Wrist (nondominant hand) – Measures the ulna & radius
- Heel (nondominant)
- Hand (nondominant) – Measures a site on the 2nd, 3rd, and 4th fingers
Factors Influencing Site Choice

- Patient History
  - Avoid measuring sites of arthritis or previous fracture because of calcification
  - Spine BMD often artificially increased in elderly by spinal degenerative changes

- Trabecular vs. Cortical Bone
  - Trabecular bone changes more rapidly
  - More responsive to therapy

NOF Guidelines

“Measurements of BMD at any skeletal site have value in predicting fracture risk. However, hip BMD is the best predictor of hip fractures and it predicts fractures at other sites as well as other measurements.”

AACE Guidelines

“Peripheral measurements can identify patients with low bone mass. T-scores from peripheral devices, however, are not as sensitive or specific as those from central devices.”

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Surgeon General’s Workshop on Osteoporosis & Bone Health

“The consensus in the field is that central densitometry should be used for a definitive diagnosis whenever possible.”

KEY POINTS

Previous vertebral or hip fracture is the most important predictor of fracture risk. BMD is the best predictor of fracture risk for those without prior adult fractures.

Interpretation of Results

- Raw BMD value
- T-score
- Z-score
Raw BMD Value

- Expressed as grams of calcium per square centimeter of bone cross section (g/cm²)
- Used when comparing subsequent test results

T-score

- Describes the bone mass of the patient compared to the mean peak bone mass of a normal young adult sex-adjusted reference population using standard deviations (SD)
- 1 SD indicates about a 10-12% difference in BMD
- Relative risk for fracture increases by a factor of 2 for each SD decrease in BMD

WHO Diagnostic Categories

- Normal = BMD > -1.0 SD of young adult mean
- Osteopenia = BMD > -1 SD but < -2.5 SD below young adult mean
- Osteoporosis = BMD -2.5 SD or more below young adult mean
Fracture risk is a gradient and not a distinct cutoff point below which all patients sustain fractures.

**Z-score**
- Compares the patient with a population adjusted for age and sex
- Indicator of possible secondary bone loss
- Osteoporosis is often defined as 1.5 SD below the age-matched mean bone density
When interpreting results, must consider the BMD value and the medical history.

**Key Points**
- T-score is used in diagnosis
- Raw BMD value is used in monitoring
- When measuring more than 1 site, the lower BMD score is used to define risk
- **When monitoring:**
  - Use same device
  - Measure same skeletal site

**Monitoring: When to Repeat BMD**
- **Evidence Report/Technology**
  - Assessment by Agency for Healthcare Research & Quality (2001)
  - [www.ahrq.gov/clinic/osteosum.htm](http://www.ahrq.gov/clinic/osteosum.htm)
- The weight of evidence is currently against repeating BMD test within the first year of treatment
- There is insufficient evidence to determine whether repeating BMD tests 2 years after starting therapy is useful
**Issues Concerning BMD Testing**

- WHO definitions only apply to postmenopausal women using dual x-ray at central sites
- No standards exist to compare efficacy, value or cost of the different testing modalities

**Unanswered Questions**

- Application of WHO criteria to technologies other than dual x-ray?
- Application of WHO criteria to populations other than postmenopausal women?
- Use of ultrasound results in clinical decisions?
- Use of peripheral devices for monitoring?

**Identification & Fracture Outcomes of Undiagnosed Low BMD in Postmenopausal Women**

*Design:* Longitudinal observational study with 12 mo FU

*Patient Population:* 200,160 postmenopausal women age ≥ 50 without diagnosis of osteoporosis from 4,236 primary care practices in 34 states

*Results:*
- 39.6% had osteopenia & 7.2% osteoporosis
- Osteoporosis increased risk of fracture within 1 yr by 2.7 times & osteopenia increased by 1.7 times
- Risk factors for osteoporosis: age, hx of fracture, smoking & steroid use
- Decreased incidence associated with ERT, diuretics, exercise, high body mass index & alcohol

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Biochemical Markers

<table>
<thead>
<tr>
<th>Markers of Bone Formation Found in Serum</th>
<th>Markers of Bone Turnover Found in Urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Alkaline phosphatase</td>
<td>• Hydroxyproline</td>
</tr>
<tr>
<td>• Osteocalcin</td>
<td>• Pyridinoline</td>
</tr>
<tr>
<td>• Procollagen I extension peptides</td>
<td>• Deoxypyridinoline</td>
</tr>
<tr>
<td>• Bone specific alkaline phosphatase</td>
<td>• Telopeptide</td>
</tr>
</tbody>
</table>

Some Examples

- **Urinary bone collagen cross-links**
  - Excretion of collagen cross-links is a marker of bone resorption.
  - Pyrilinks D measures deoxypyridinoline which is found in bone and collagen.
  - Osteomark measures N-telopeptide which comes exclusively from bone.

- **Blood tests**
  - Ostease measures blood level of bone specific alkaline phosphatase; can help determine if new bone is being formed.

BMD and Biochemical Bone Markers

- **BMD** provides information on:
  - Risk of fracture
  - Losing or gaining bone mass (at 12-24 month intervals)

- **Resorption markers** provide additive information on:
  - Which patients may respond best to antiresorptive therapies
  - Which patients are not responding to the prescribed antiresorptive regimen (within 3 months)
Use of Biochemical Markers

- Clinical utility is not clear at this time
- Thought to be useful in monitoring treatment but are not for diagnosis
- May help predict which patients might respond better to different therapies

Use of Biochemical Markers

  - www.ahrq.gov/clinic/osteosum.htm
  - There is a small correlation between response to therapy as measured by densitometry and marker results, but no marker is accurate enough to reliably identify those individual who will fail to respond to treatment

Osteoporosis is the end product of a multifactorial process leading to a reduction of bone mass to the point at which fractures occur under stresses that would be tolerated by normal bone.
Application Exercise #1
Identifying Risk Factors for Osteoporosis
& Evaluating BMD Screening Results

Case Presentation
- Ms. Green is a 54-year-old Caucasian female requesting BMD testing during a screening program
- Ms. Green lives a fairly active life enjoying a number of outdoor activities
- She is health conscious and is concerned about the possibility of developing osteoporosis

Medical History
- Current medical problems
  - Hypertension: started drug therapy 2 years ago, well controlled
  - Hypothyroidism: well controlled on thyroid supplementation for the past 4 years
- Current medications
  - Enalapril 5 mg once daily
  - Levothyroxine 0.125 mg daily
  - Centrum® Silver® 1 once daily
  - ASA 325 mg once daily
What potential risk factors have you identified at this point?

A. Hypothyroidism
B. Hypertension
C. Use of thyroid hormone supplement
D. No risk factors identified

Best Answer

C. Use of thyroid hormone supplement
- Excessive thyroid hormone use may cause bone loss
- Does patient receive routine medical follow-up for her hypothyroidism & have TSH levels periodically monitored?

Medical History
- Menstrual history
  - Age of menarche: 15 yo
  - Age at menopause: 50 yo, occurred naturally
  - No history of amenorrhea
- Family history
  - Grandmother & great aunt on her mother’s side had osteoporosis
- Body type
  - Petite, slim
  - Current weight: 125 lb
- No history of bone fractures
What additional risk factors have you identified?

A. Positive family history
B. Small body frame & low body weight
C. A and B
D. No additional risk factors identified

Best Answer

B. Small body frame & low body weight
   - According to NOF, weight <127 lbs is a risk factor

Lifestyle / Environmental Factors

- Non-smoker
- Drinks 1 glass of red wine most days
- Drinks 2 cups of coffee each morning
- Generally drinks 1 or 2 glasses of iced decaffeinated green tea daily
- Rarely consumes soda
What additional potential risk factors have you identified?

A. Excessive caffeine
B. Excessive alcohol
C. A and B
D. No additional risk factors identified

Best Answer

D. No additional risk factors identified

- Excessive alcohol use is defined as greater than 1 oz of ethanol/day (8 oz of wine)
- Excessive caffeine is defined as greater than 2 servings/day

Summarize Ms. Green’s Identifiable Risk Factors

- Female
- Caucasian
- Body weight <127 lb
- Possibly: excessive thyroid hormone

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Which of the following counseling points are appropriate for Ms. Green?

A. Continue routine follow up with physician regarding management of hypothyroidism
B. Do not increase ingestion of caffeine containing products
C. Gain some weight
D. A & B

Best Answer

D. A and B
- Continue routine follow up with physician regarding management of hypothyroidism
- Do not increase ingestion of caffeine containing products

Considerations

- Develop a tool to facilitate data collection and recording
- Osteoporosis Care Toolkit: Patient History/Data Base
BMD Screening

- Ms. Green undergoes a peripheral BMD test of her heel using an ultrasound device
- Results: T-score of -1.8

Is Ms. Green an appropriate candidate for BMD testing according to NOF guidelines?

A. Yes
B. No

Candidates for BMD Testing

NOF Guidelines

- All women >65 years old regardless of additional risk factors
- All postmenopausal women <65 years old who have 1 or more additional risk factors for osteoporosis
  - Family history of osteoporosis
  - Personal history of low-trauma fracture after age 45
  - Current cigarette smoking
  - Low body weight
According to the WHO diagnostic categories, where does Ms. Green’s T-score fall?

A. Normal
B. Osteopenia
C. Osteoporosis

WHO Diagnostic Categories

- Normal = BMD > -1.0 SD of young adult mean
- Osteopenia = BMD > -1 SD but < -2.5 SD below young adult mean
- Osteoporosis = BMD -2.5 SD or more below young adult mean

Osteoporosis Care Tool Kit

- Components of the tool kit will be used during different modules of the NIPCO-accredited Osteoporosis Care Certificate Program
- Available for your use after completing the course
Osteoporosis Care Tool Kit –
Patient Care Resources
- Patient History/Data Base for Osteoporosis
- Osteoporosis/Fracture Prevention Plan
- Osteoporosis Patient Monitoring Form
- Bone Density Consent Form
- CPT Codes for BMD Tests
- CPT Codes for Medication Therapy Management and Monitoring
- Statement of Medical Necessity
- Health Insurance Claim Forms

Osteoporosis Care Tool Kit –
Business Related Resources
- Competitive Analysis Worksheet
- Bone Density Screening Supply and Equipment Checklist
- Osteoporosis Management and Screening Service Business Plan
- Return on Investment Analysis

Osteoporosis Care Certificate Program
Boning Up on Osteoporosis
- Introduction and Background Pathophysiology
- Determinants of Peak Bone Mass and Rate of Loss
- Osteoporotic Fractures
- Diagnosis and Monitoring of Osteoporosis

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Chek Point

How Well Are You Able to:
- Define osteoporosis and describe its prevalence and classification
- Describe the basic pathology of osteoporosis
- Discuss the risk factors associated with developing osteoporosis
- Identify some secondary causes of osteoporosis
- Describe the clinical presentation of osteoporosis
- Explain the role of DXA and ultrasound devices in clinical practice and the limitations of use
- Define T-score and list the diagnostic categories based on this measurement

Take Time to Review if Necessary
- Define osteoporosis and describe its prevalence and classification
- Describe the basic pathology of osteoporosis
- Discuss the risk factors associated with developing osteoporosis
- Identify some secondary causes of osteoporosis
- Describe the clinical presentation of osteoporosis
- Explain the role of DXA and ultrasound devices in clinical practice and the limitations of use
- Define T-score and list the diagnostic categories based on this measurement

Thank you for your participation.